

# **Damp Indoor Spaces and Health: The IOM Report; What It Means for Schools**

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**Air Quality Program**

# **The Institute of Medicine**

- **Part of the National Academies of Science**
- **Chartered in 1970 to “enlist members of the medical and other professions in the study of problems that affect public health.”**

# **CDC's charge to the committee**

- **Conduct a comprehensive review of the scientific literature regarding the relationship between damp or moldy indoor environments and the manifestation of adverse health effects, particularly respiratory and allergic symptoms**
- **Focus on fungi and their secondary metabolites, including mycotoxins**

# **The committee assessed the literature to answer these questions**

- **What does science and experience tell us about damp buildings?**
- **What do we know about assessing exposure to mold and other microbial agents?**
- **What does science tell us about toxic effects of molds and bacteria**
- **Is there evidence linking indoor exposure to dampness and dampness-related agents and health outcomes?**
- **What are the elements of a dampness prevention or remediation effort and what's known about their effectiveness?**

# **Who are the Agents of Illness?**

## **How do they make us ill?**

- **Allergic agents**

molds, bacteria, dust mites, endotoxins, roaches, bird and bat guano or dander (cat, dog, rodent)

- **Toxic agents**

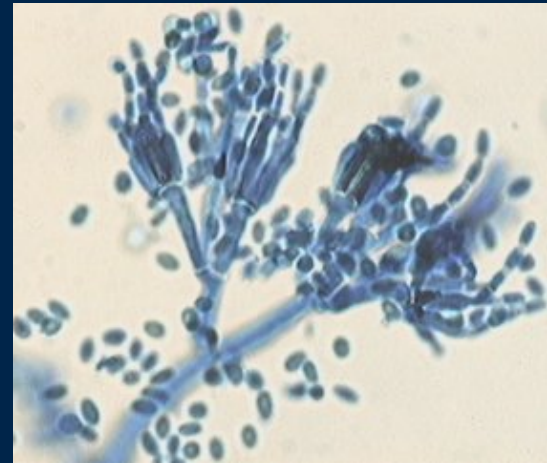
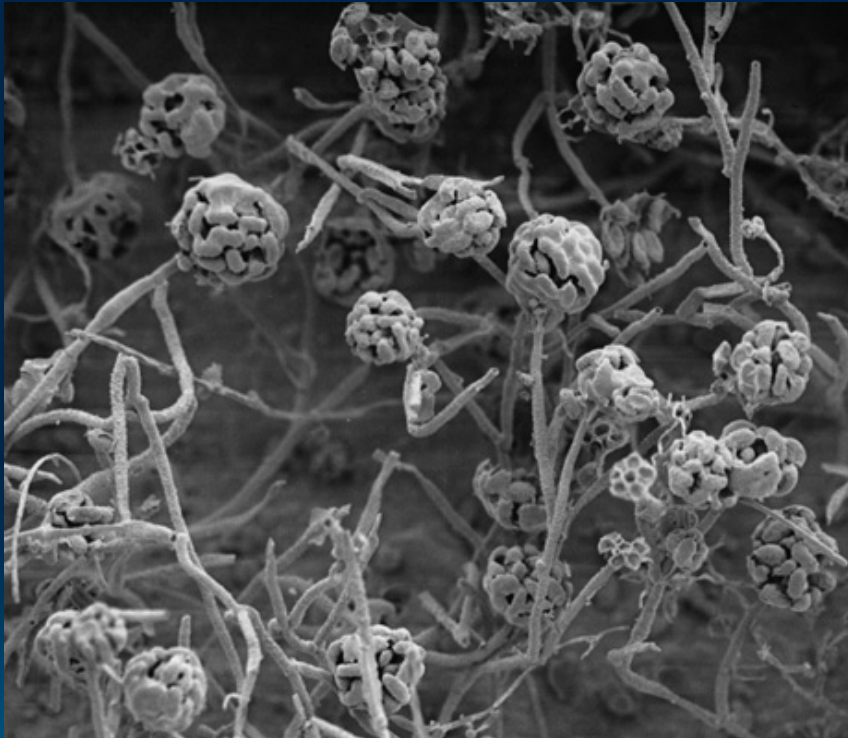
bacterial endotoxins, mycotoxins

- **Inflammatory agents**

all listed above, plus  $\beta$ -D-glucans, mold VOCs, gaseous and particulate air pollutants

# **Who are suspects for allergic, toxic, and inflammatory reactions?**

- **Mold Spores (assumed agents of exposure)**
- **Hyphal fragments**
- **Dust from growth substrate**
- **Bacteria**
- **Bacterial fragments**
- **Bacterial toxins**
- **Fungal toxins**





# What is the meaning of „Damp Environment“?

FRANKFURTER ALLGEMEINE SONNTAGSZEITUNG, 6. JUNI 2004, NR. 23

## Wie schimmelig ist mein Häuschen?

Pilze an den Wänden hat niemand gern. In Amerika allerdings ruft das regelrechte Hysterie hervor. Dabei weiß niemand, wie ungesund der Befall wirklich ist.

VON JULIA GROSS

Vor diesem ungebetenen Gast schützt nicht einmal Prominenz. Brad Pitt und Jennifer Aniston zum Beispiel hatten ihn bereits – in der Garage ihres 15-Millionen-Dollar-Anwesens. Und Bianca Jagger, Ex-Frau von Mick Jagger, verklagte ihren New Yorker Vermieter deswegen auf 20 Millionen Dollar Schadenersatz.

Die Rede ist von *toxic mold*. Zu deutsch: Giftschimmel. Erzfeind des Hausbesitzers, Albtraum aller Mieter, Goldgrube für Hersteller obskurer Sporen-Detektoren und geschäftstüchtige Rechtsanwälte. In den Vereinigten Staaten ist die Angst vorm Pilzbefall fast schon zur nationalen Obsession geworden. *Toxic mold* soll für Asthma, Dauermüdigkeit, Gedächtnisverlust und unzählige andere Leiden bis hin zu Persönlichkeitsveränderungen verantwortlich sein.

Ein 64seitiges, engbedrucktes Papier, das man in Kalifornien gleichzeitig mit dem Mietvertrag unterschreiben muß, nennt den Schimmel in einem Atemzug mit möglichen Gefahren durch Erdbeben oder Asbest. Wegen *toxic mold* werden Schulen geschlossen, boykottieren Mitarbeiter ihre Büros, verlassen Familien fluchtartig ihr Zuhause. Schon der Anblick jener Männer in Schutzanzügen, die zur

Schimmelbekämpfung beim Nachbarn anrücken, reicht aus, den amerikanischen Vorortfrieden nachhaltig zu erschüttern. Rund 10 000 Gerichtsverfahren seien wegen Haus-Schimmels anhängig, teilt die Alliance of American Insurers mit. 2002 sollen Versicherungen Schäden in Höhe von drei Milliarden Dollar beglichen haben. Seit die Texanerin Melinda Ballard 2001 in erster Instanz 32 Millionen Dollar Schadenersatz zugesprochen bekam, wurde in den meisten Bundesstaaten das Risiko „mold“ aus Versicherungsverträgen ausgeschlossen.

Dunkle Spuren an der Wand kommen überall auf der Welt vor, wo es feucht wird. Auch in Deutschland werden Prozesse geführt. Aber nirgends treibt das Phänomen so bunte Blüten wie in den Vereinigten Staaten. Gedeihen die Schimmelpilze in der Neuen Welt einfach besser? Die Erklärung ist gar nicht so abwegig. Tatsächlich ist das Klima dort häufig wärmer und feuchter – gerade so, wie es Schimmelpilze mögen. Klimaanlage, in denen sich die Organismen mit Vorliebe einnisten, gehören vielerorts zur Standardausstattung. Dazu kommt die amerikanische Angewohnheit, Häuser und Wohnungen möglichst flächendeckend mit langflorigen Teppichen auszuliegen. Ganz zu schweigen vom vorherrschenden Baumaterial Holz, das dem ziegelsteinverwöhnten Europäer meist schlampig verarbeitet vorkommt. Alles Faktoren, die die Ansiedlung von Schimmelpilzen zumindest begünstigen.

„Außerdem wird gerade in den letzten Jahren beim Hausbau mehr Wert auf gute Isolierung gelegt. Mit der Folge, daß man Feuchtigkeit, wenn sie einmal da ist, schwer wieder los wird“, sagt Tom Volk,



Im Gorgonzola erwünscht, im Eigenheim weniger:



# **How do we measure exposure?**

- **Questionnaire studies and their problems:**

**how do researchers describe dampness?**

**Researcher observation?**

**Report of occupants?**

**Dampness? Wet spots? History of water problems? Visible mold growth?**

**Sampling?...by what means?**

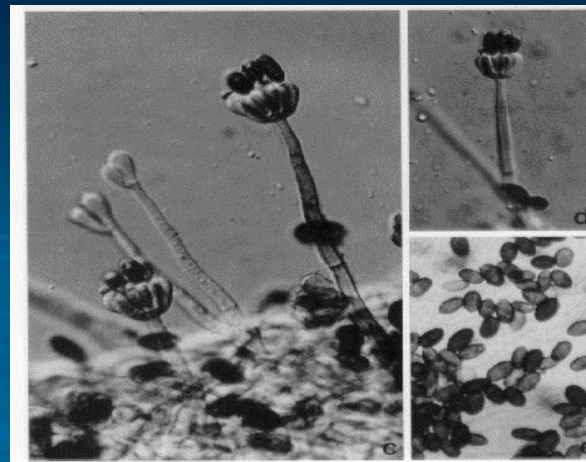
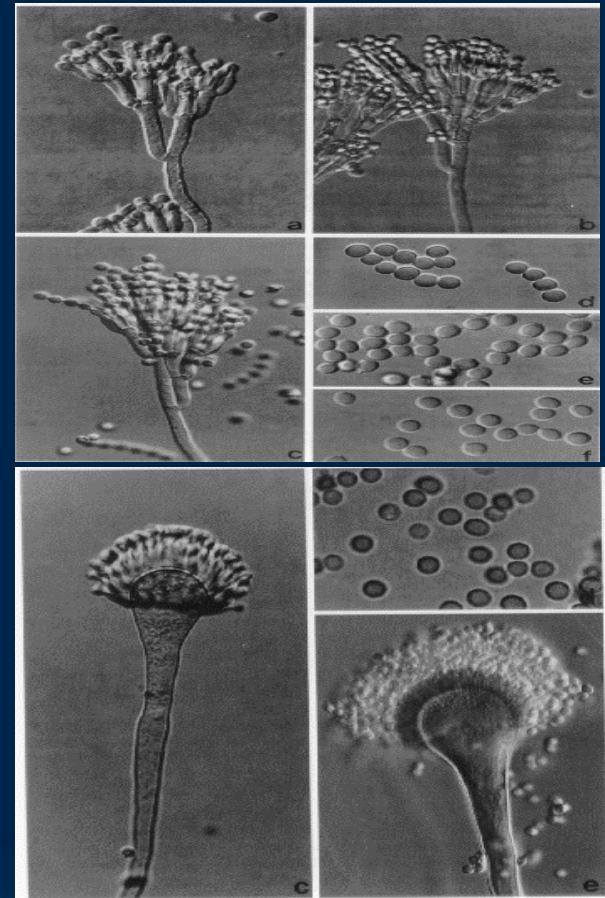
- **Exposure agents: imperfect means of sampling presumed agents: mold and bacteria and their products**
- **Are we measuring the right exposure agents?**
- **What is the relationship between sampling and exposure of subjects**
- **Lack of biomarkers**

# **Measurement of Agents Thought Associated with Health Effects**

- **Mold Spores**
- **Bacteria**
- **Endotoxin**
- **B-D-glucan**
- **Mycotoxins**
- **Spore and hyphal fragments, small particles generated by molds; substrate dust with adsorbed allergens, toxins**

# Mold Spores

- **Spore traps:** pump collects dead and live spores from air onto transparent slide; Identified by microscopy; only a few spores are distinctive



# Mold Spores

- **Viable samplers:** Pump pulls air onto solid (agar) or liquid growth medium which is incubated and colonies isolated; medium can be selective or general
- Molds have differing nutrient, pH, water requirements, compete for these and inhibit each other. And may not grow on medium or grow differentially
- Sampler may destroy spores: won't grow



# Where and when to sample?

- **Sampling times: minutes**  
air concentrations vary in time as molds bloom and vary by air currents, occupant activity
- **Number and place of sampling:**  
indoor: outdoor (where?)  
where are indices of contamination such as water stains, visible mold (to whom?), musty odors, etc.

**Is there a need to sample here?**



# **Why sample for any of the putative agents?**

- **To determine if contamination exists: is this possible or practicable? Are there better means to find this out?**
- **To determine exposure: not likely because of temporal and location sampling limitations**
- **Relationship with health effects: if you can't measure exposure, how can you determine a concentration effect relationship?**

# Human Health Effects

- **Epidemiological studies were the primary source of information for health outcomes**
  - These mostly examine general population exposure to dampness or to dampness-related agents in the home; committee separated studies on “dampness” and “agents”
  - A few clinical studies were considered
  - The committee struggled to distinguish “lack of evidence” from “lack of study”

# Categories of Association

**The committee used a uniform set of qualitative categorizations to evaluate epidemiological studies:**

- Sufficient evidence: studies in which chance, bias and confounding can be ruled out with reasonable certainty**
- Limited/ suggestive association: chance, bias and confounding cannot be ruled out with confidence**
- Inadequate/ insufficient evidence of association: existing studies are of insufficient quality, consistency or statistical power to permit a conclusion of association. Alternatively, no studies exist that have examined a relationship. Association could not be ruled in or out.**



# **Association with Exposure to Damp Environments**

- **Sufficient study and evidence of an association:**
  - **Asthma symptoms in sensitized persons**
  - **Cough**
  - **Upper respiratory (nasal and throat) tract symptoms**
  - **Wheeze**

# **Association with Exposure to Damp Environments**

- **Limited/ suggestive study, evidence of an association:**
  - **Asthma development**
  - **Dyspnea (labored breathing)**
  - **Lower respiratory illness in otherwise healthy, non-atopic children**

# **Association with Exposure to Damp indoor Environments: Lacking, Inadequate/Insufficient Studies**

- **Airflow obstruction in healthy person**
- **Mucous membrane irritation syndrome**
- **Chronic obstructive pulmonary disease**
- **Inhalation fevers**
- **Lower respiratory illness in healthy adults**
- **Acute idiopathic pulmonary hemorrhage in infants**
- **Skin symptoms**
- **Gastrointestinal symptoms**
- **Fatigue**
- **Neuropsychiatric symptoms**
- **Cancer**
- **Reproductive effects**
- **Rheumatologic and other immune disorders**

# **Association with Presence of Mold or Other Agents in Damp Indoor Spaces**

- **Sufficient evidence of an association:**
  - Asthma symptoms in sensitized persons
  - Cough
  - Hypersensitivity pneumonitis in susceptible persons
  - Upper respiratory tract (nose, throat) symptoms
  - Wheeze
- **Limited/Suggestive evidence of association:**
  - Lower respiratory illness in healthy (non-atopic) children

# **Association with Presence of Mold or Other Agents in Damp Indoor Spaces**

## **Lacking, Inadequate or insufficient studies:**

- **Dyspnea**
- **Airflow obstruction in healthy persons**
- **Mucous membrane irritation syndrome**
- **COPD**
- **Inhalation fevers**
- **Lower respiratory illness in healthy adults**
- **Asthma development**
- **Acute idiopathic pulmonary hemorrhage in infants**
- **Skin symptoms**
- **GI tract problems**
- **Fatigue**
- **Neuropsychiatric symptoms**
- **Cancer**
- **Reproductive effects**
- **Rheumatologic and other immune diseases**



# **Role of Toxic and Inflammatory Agents?**

- **Less clear than allergic agents because investigators**
  - 1. Did Not Sample for Toxic Agents (techniques few)**
  - 2. Sampling Limited**
  - 3. Toxic or inflammatory agents not determined or determined qualitatively**
    - lack of methods for determining carrier of toxicity, inflammation, lack of methods for identifying, quantifying exposure to toxic or inflammatory agents**

# Findings from Toxicity Chapter

- **Mycotoxin-producing molds can and do grow in damp indoor spaces**
- ***In vitro* and animal studies show toxicity can occur via inhalation and dermal exposure**
- **Such studies show adverse immunotoxic, neurological, respiratory and dermal effects**
- **Such studies of toxigenic *Stachybotrys chartarum* strains indicate biological plausibility for toxic effects in humans**
- **Biomarkers for exposure needed**
- **Basic science of LOAEL/NOAEL needed for risk assessment**

# **Dampness**

## **Its Cause and Prevention**

- **Water Intrusion (roof, walls, doors, windows, foundation)**
- **Plumbing leaks, catastrophic accidents**
- **Floods**
- **Condensation**

**Much known about good design,  
building practices: knowledge must be  
disseminated**

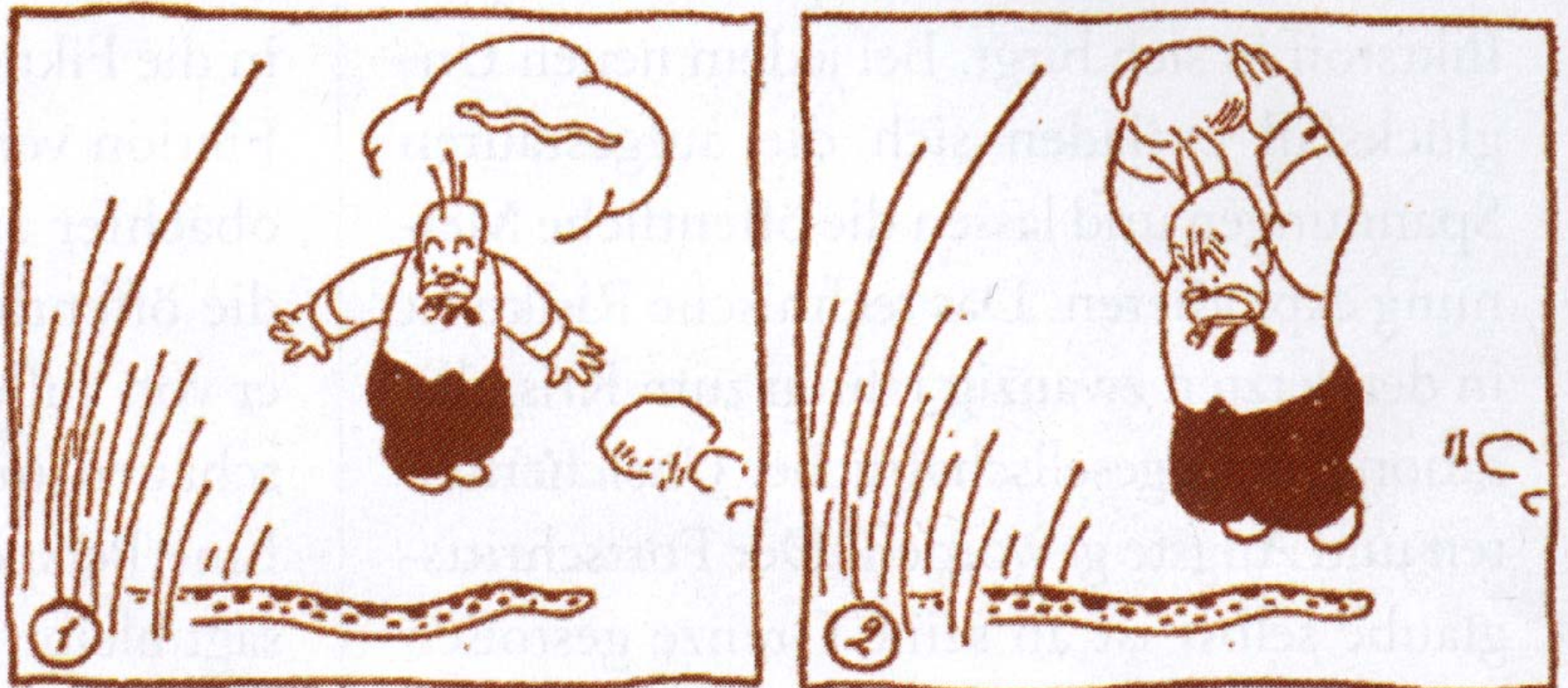
# **Dampness**

## **Its Cause and Prevention**

- **Water Intrusion can be prevented by appropriate design, best building practices, and proper maintenance**
- **When water intrusion occurs it must be dealt with promptly**
- **Condensation problems can be dealt with through appropriate ventilation and prevention of overcrowding**



# ***Risiken (richtig) einschätzen ..... (True) Hazard Evaluation***

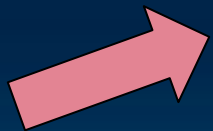
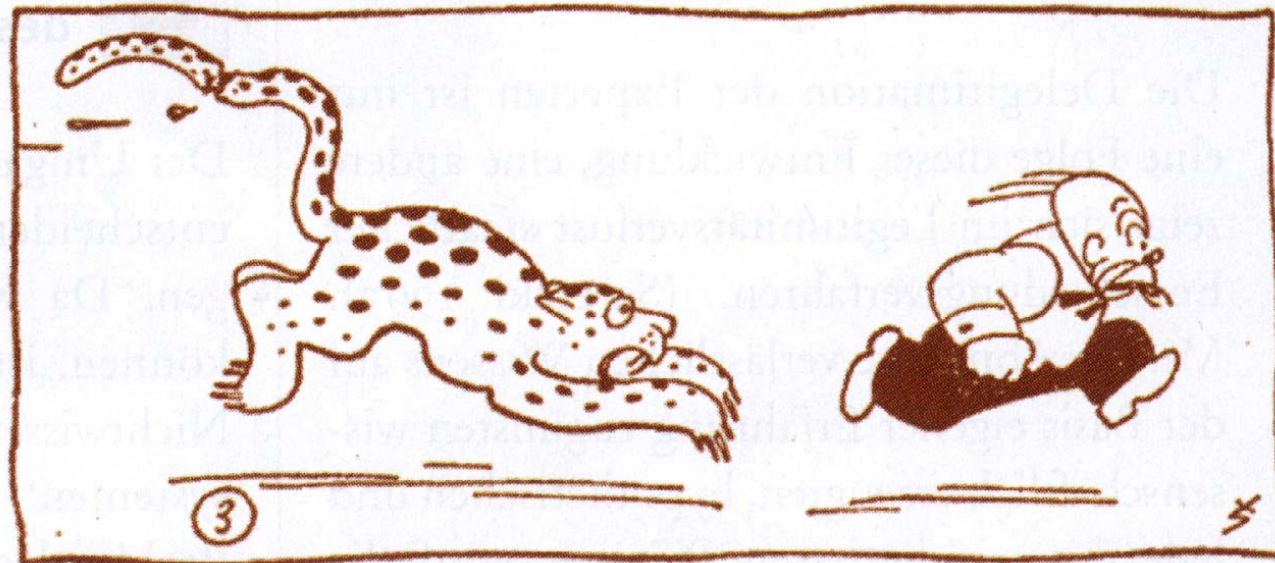
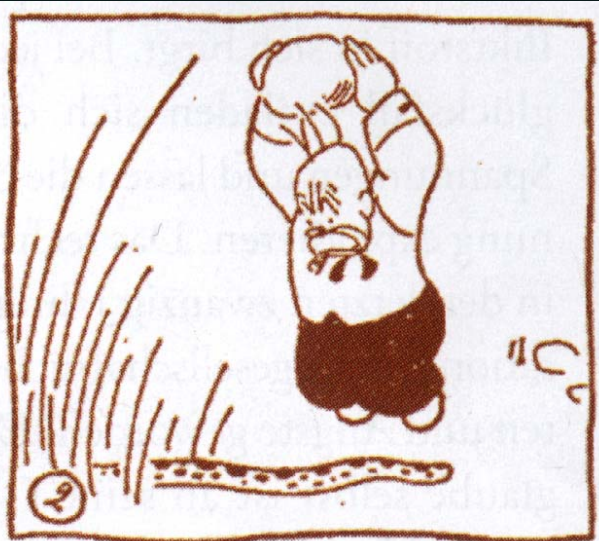


*Wissenschaftliche Risikokommunikation oder die Kunst,  
»Nichtwissen« zu managen* G. Bechthold in Forum DKG 5/04



# *Risikowahrnehmung .....*

## *Hazard Apprehension*



# Public Health Concern

- **Precise extent of dampness problem not known, but problem extends across economic classes; substandard housing more affected**
- **Role in allergic disease alone significant; extent of toxic and inflammatory agents not well studied. Significant needs for determining means of exposure, effects indoors**

# Children at Risk

- Lung, immune other defenses not fully formed
- Breathe more air per body weight than adults
- School **occupancy per square foot greater than for any other building except theaters (ventilation is key)**
- Long exposure hours

# Prevention is Key

- **Proper design for climate, siting, construction imperative**
- **Awareness of moisture problems and immediate attention imperative**
- **Maintenance is imperative (yet maintenance budgets often first to be cut when school budget belts are tightened)**
- **Investigation, remediation, clean-up is far more costly**

# **Public Health Intervention**

- **While published intervention studies are few (more since report published), methodologies for keeping buildings dry and clean are known.**
- **Education on several levels needed:**
  - **architects, engineers, builders**
  - **home owners, building managers**
  - **physicians, care givers**
  - **school districts, and all occupants**

# Committee Recommendations

- **Building dampness is a public health problem that should be addressed at the local, state and federal level**
- **HUD should provide support for consensus guidelines on building design, construction, maintenance for prevention of moisture problems**
- **Basic science on exposure, toxicity, efficacy of moisture control, and remediation of contamination is needed and should be funded**
- **Public outreach to occupants, and to those responsible for design, construction and maintenance for prevention and remediation of moisture problems is needed**